

**What Is Claimed Is:**

12/12/12

1 1. A method of processing a plurality of keep-alive messages generated by a  
2 corresponding plurality of end systems, each of said plurality of keep-alive messages being  
3 designed to request the status of a corresponding point to point (PPP) session implemented  
4 on a communication network, said method comprising:

5 receiving in an aggregation device said plurality of keep-alive messages;

6 generating in said aggregation device an aggregated request packet which indicates  
7 that the status of said PPP sessions is requested; and

8 sending said aggregated request packet on said communication network to a peer  
9 aggregation device.

1 2. The method of claim 1, further comprising:

2 receiving said aggregated request packet in said peer aggregation device;

3 indicating the status of said plurality of sessions in an aggregated reply packet; and

4 sending said aggregated reply packet to said aggregation device.

1 3. The method of claim 1, further comprising receiving in said aggregation device an  
2 aggregated reply packet from said peer aggregation device, wherein said aggregated reply  
3 packet indicates the status of at least some of said plurality of PPP sessions.

1 4. The method of claim 3, further comprising sending a proxy keep-alive reply  
2 message to one of said plurality of end systems originating a corresponding one of said keep  
3 alive-messages without waiting for said aggregated reply packet.

A12

Page 18 of 28

1 5. The method of claim 4, further comprising:  
2 maintaining a remote status table in said aggregation device, wherein said remote  
3 status table indicates the status of sessions supported by said aggregation device;  
4 updating said remote status table with the information in said aggregated reply packet;  
5 and  
6 generating said proxy keep-alive reply according to said remote status table.

1 6. The method of claim 5, wherein said proxy keep-alive message indicates that the  
2 corresponding session is alive/OK when a first keep-alive message is received for the  
3 corresponding session.

1 7. The method of claim 6, further comprising initializing the status of each of said  
2 session to alive/OK such that said proxy keep-alive message in response to said first keep-  
3 alive message indicates alive/OK status.

1 8. The method of claim 1, wherein said communication network is implemented  
2 using one of frame relay, ATM and IP networks.

1 9. The method of claim 1, wherein said aggregation device is one of a network access  
2 server and home gateway.

1 10. A method of processing an aggregated request packet in an aggregation device,  
2 wherein said aggregated request packet indicates that the status of a plurality of point-to-point  
3 sessions are requested, said method comprising:

4 examining said aggregated request packet to determine said plurality of point-to-point  
5 sessions;  
6 determining the status of each of said plurality of point-to-point sessions;  
7 generating an aggregated reply packet indicating the status of said plurality of point-  
8 to-point sessions; and  
9 sending said aggregated reply packet to said peer aggregation device.

11. The method of claim 10, wherein said determining comprises accessing a local  
status table which contains the status information of at least some of said plurality of point-  
to-point sessions.

12. The method of claim 10, wherein said generating comprises including a client  
magic number associated with each of said plurality of point-to-point sessions.

13. The method of claim 10, wherein said generating comprises setting a bit to one  
logical value to indicate that a corresponding one of said plurality of sessions is OK/alive,  
and to another logical value to indicate that said corresponding one of said plurality of  
session not OK/alive.

14. The method of claim 10, wherein said aggregation device comprises one of a  
network access server (NAS) and a home gateway implemented in a communication network.

15. An aggregation device for processing a plurality of keep-alive messages  
generated by a corresponding plurality of end systems, each of said plurality of keep-alive

3 messages being designed to request the status of a corresponding point to point (PPP) session  
4 implemented on a communication network, said aggregation device comprising:

5 an input interface receiving said plurality of keep-alive messages;

6 a message aggregator coupled to said input interface, said message aggregator  
7 examining said plurality of message and generating data according to a format indicating that  
8 the status of said PPP sessions is requested; and

9 an output interface sending an aggregated request packet on said communication  
10 network to a peer aggregation device, said aggregated request packet containing said data  
11 generated by said message aggregator.

1 16. The aggregation device of claim 15, further comprising an encapsulator  
2 encapsulating said data in a packet suitable for transmission on said communication network.

1 17. The aggregation device of claim 16, further comprising:  
2 a remote status table indicating the status of sessions supported by said aggregation  
3 device; and

4 a de-aggregator receiving an aggregated reply packet from said peer aggregation  
5 device, wherein said aggregated reply packet indicates the status of at least some of said  
6 plurality of PPP sessions, said de-aggregator updating said remote status table with the  
7 information in said aggregated reply packet.

1 18. The aggregation device of claim 17, further comprising a proxy reply unit sending  
2 a proxy keep-alive reply message to one of said plurality of end systems originating a  
3 corresponding one of said keep alive-messages without waiting for said aggregated reply

4 packet.

1 19. The invention of claim 18, wherein said aggregation device comprises a network  
2 access server.

1 20. The aggregation device of claim 18, wherein said aggregated request packet  
2 contains a magic number related to each of the corresponding sessions.

1 21. An aggregation device for processing a plurality of keep-alive messages  
2 generated by a corresponding plurality of end systems, each of said plurality of keep-alive  
3 messages being designed to request the status of a corresponding point to point (PPP) session  
4 implemented on a communication network, said aggregation device comprising:

5 first means for receiving said plurality of keep-alive messages;

6 means for generating an aggregated request packet which indicates that the status of  
7 said PPP sessions is requested; and

8 means for sending said aggregated request packet on said communication network to  
9 a peer aggregation device.

1 22. The aggregation device of claim 21, further comprising second means for  
2 receiving an aggregated reply packet from said peer aggregation device, wherein said  
3 aggregated reply packet indicates the status of at least some of said plurality of PPP sessions.

1 23. The aggregation device of claim 22, further comprising means for sending a  
2 proxy keep-alive reply message to one of said plurality of end systems originating a

3 corresponding one of said keep alive-messages without waiting for said aggregated reply  
4 packet.

1 24. The aggregation device of claim 23, further comprising:  
2 means for maintaining a remote status table in said aggregation device, wherein said  
3 remote status table indicates the status of sessions supported by said aggregation device;  
4 means for updating said remote status table with the information in said aggregated  
5 reply packet; and  
6 means for generating said proxy keep-alive reply according to said remote status table.

1 25. An aggregation device for processing an aggregated request packet, wherein  
2 said aggregated request packet indicates that the status of a plurality of point-to-point  
3 sessions are requested, said aggregation device comprising:  
4 means for examining said aggregated request packet to determine said plurality of  
5 point-to-point sessions;  
6 means for determining the status of each of said plurality of point-to-point sessions;  
7 means for generating an aggregated reply packet indicating the status of said plurality  
8 of point-to-point sessions; and  
9 means for sending said aggregated reply packet to said peer aggregation device.

1 26. The aggregation device of claim 25, wherein said means for determining  
2 comprises means for accessing a local status table which contains the status information of  
3 at least some of said plurality of point-to-point sessions.

1 27. The aggregation device of claim 25, wherein said means for generating includes  
2 a client magic number associated with each of said plurality of point-to-point sessions.

1 28. The aggregation device of claim 25, wherein said means for generating sets a bit  
2 in said aggregated reply packet to one logical value to indicate that a corresponding one of  
3 said plurality of sessions is OK/alive, and to another logical value to indicate that said  
4 corresponding one of said plurality of session not OK/alive.

1 29. The aggregation device of claim 25, wherein said aggregation device comprises  
2 one of a network access server (NAS) and a home gateway implemented in a communication  
3 network.

1 30. An aggregation device for processing an aggregated request packet, wherein  
2 said aggregated request packet indicates that the status of a plurality of point-to-point  
3 sessions are requested, said aggregation device comprising:

4 an input interface receiving said aggregated request packet;

5 a de-encapsulator examining said aggregated request packet to determine that said  
6 aggregated request packet relates to requesting the status of point-to-point sessions;

7 a reply generator determining the status of each of said plurality of point-to-point  
8 sessions, and generating an aggregated reply packet indicating the status of said plurality of  
9 point-to-point sessions; and

10 an output interface sending said aggregated reply packet to said peer aggregation  
11 device.

1 31. The aggregation device of claim 30, further comprising a local status table storing  
2 the status information of at least some of said plurality of point-to-point sessions, wherein  
3 said reply generator determines the status of said at least some of said plurality of point-to-  
4 point sessions by accessing said local status table.

1 32. The aggregation device of claim 31, further comprising a session manager  
2 updating the status of said plurality of point-to-point sessions in said local status table.

1 33. The aggregation device of claim 30, wherein said reply generator includes in said  
2 aggregated reply packet a client magic number associated with each of said plurality of point-  
3 to-point sessions.

1 34. The aggregation device of claim 30, wherein said reply generator sets a bit in said  
2 aggregated reply packet to one logical value to indicate that a corresponding one of said  
3 plurality of sessions is OK/alive, and to another logical value to indicate that said  
4 corresponding one of said plurality of session not OK/alive.

1 35. The aggregation device of claim 30, further comprising a keep-alive processor  
2 coupled to said de-encapsulator, wherein said keep-alive processor examines said aggregated  
3 request packet to determine that status of point-to-point sessions is requested and causes said  
4 reply generator to generate said aggregated reply packet.

1 36. The aggregation device of claim 30, wherein said aggregation device comprises  
2 one of a network access server (NAS) and a home gateway implemented in a communication

3 network.

1 37. A computer-readable medium carrying one or more sequences of instructions for  
2 causing a aggregation device to process a plurality of keep-alive messages generated by a  
3 corresponding plurality of end systems, each of said plurality of keep-alive messages being  
4 designed to request the status of a corresponding point to point (PPP) session implemented  
5 on a communication network, wherein execution of said one or more sequences of  
6 instructions by one or more processors contained in said aggregation device causes said one  
7 or more processors to perform the actions of:

8 receiving in an aggregation device said plurality of keep-alive messages;  
9 generating in said aggregation device an aggregated request packet which indicates  
10 that the status of said PPP sessions is requested; and  
11 sending said aggregated request packet on said communication network to a peer  
12 aggregation device.

1 38. The computer-readable medium of claim 37, further comprising:  
2 receiving said aggregated request packet in said peer aggregation device;  
3 indicating the status of said plurality of sessions in an aggregated reply packet; and  
4 sending said aggregated reply packet to said aggregation device.

1 39. The computer-readable medium of claim 37, further comprising receiving in said  
2 aggregation device an aggregated reply packet from said peer aggregation device, wherein  
3 said aggregated reply packet indicates the status of at least some of said plurality of PPP  
4 sessions.

1 40. The computer-readable medium of claim 39, further comprising sending a proxy  
2 keep-alive reply message to one of said plurality of end systems originating a corresponding  
3 one of said keep alive-messages without waiting for said aggregated reply packet.

1 41. The computer-readable medium of claim 40, further comprising:  
2 maintaining a remote status table in said aggregation device, wherein said remote  
3 status table indicates the status of sessions supported by said aggregation device;  
4 updating said remote status table with the information in said aggregated reply packet;  
5 and  
6 generating said proxy keep-alive reply according to said remote status table.

1 42. A computer-readable medium carrying one or more sequences of instructions for  
2 causing an aggregation device to process an aggregated request packet, wherein said  
3 aggregated request packet indicates that the status of a plurality of point-to-point sessions are  
4 requested, wherein execution of said one or more sequences of instructions by one or more  
5 processors contained in said aggregation device causes said one or more processors to  
6 perform the actions of:  
7 examining said aggregated request packet to determine said plurality of point-to-point  
8 sessions;  
9 determining the status of each of said plurality of point-to-point sessions;  
10 generating an aggregated reply packet indicating the status of said plurality of point-  
11 to-point sessions; and  
12 sending said aggregated reply packet to said peer aggregation device.

1 43. The computer-readable medium of claim 42, wherein said determining comprises  
2 accessing a local status table which contains the status information of at least some of said  
3 plurality of point-to-point sessions.

1 44. The computer-readable medium of claim 42, wherein said generating comprises  
2 including a client magic number associated with each of said plurality of point-to-point  
3 sessions.

1 45. The computer-readable medium of claim 42, wherein said generating comprises  
2 setting a bit to one logical value to indicate that a corresponding one of said plurality of  
3 sessions is OK/alive, and to another logical value to indicate that said corresponding one of  
4 said plurality of session not OK/alive.

1 46. The computer-readable medium of claim 42, wherein said aggregation device  
2 comprises one of a network access server (NAS) and a home gateway implemented in a  
3 communication network.